OPPD
Omaha Public Power District
444 South 16th Street Mall
Omaha, Nebraska 68102-2247

November 24, 1999
LIC-99-0109

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station P1-137
Washington, DC 20555

Reference: Docket No. 50-285

Subject: Licensee Event Report 1999-004 Revision 0 for the Fort Calhoun Station

Please find attached Licensee Event Report 1999-004, Revision 0, dated November 24, 1999. This report is being submitted pursuant to 10 CFR 50.73(a)(2)(iv), 10 CFR 50.73(a)(2)(v)(B), and 10 CFR 50.73(a)(2)(vii)(B). If you should have any questions, please contact me.

Sincerely,

R. L. Phelps
Division Manager
Nuclear Engineering

EPM/epm

Attachment

c: E. W. Merschoff, NRC Regional Administrator, Region IV
L. R. Wharton, NRC Project Manager
W. C. Walker, NRC Senior Resident Inspector
INPO Records Center
Winston and Strawn

IE22

NRC FORM 366 (6-1998) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 06/30/2001

Estimated burden per response to comply with this mandatory information collection request: 50 hrs. Reported lessons learned are incorporated into the licensing process and fed back to industry. Forward comments regarding burden estimate to the Records Management Branch (T-6 F33), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, and to the Paperwork Reduction Project (3150-0104), Office of Management and Budget, Washington, DC 20503. If an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Fort Calhoun Nuclear Station Unit Number 1	05000285	1 OF 4

TITLE (4)

Loss of Both Station Vital Buses While Transferring Station Lighting

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
10	26	1999	1999	– 004 –	00	11	24	1999		05000
									FACILITY NAME	DOCKET NUMBER
										05000

OPERATING MODE (9)	5
POWER LEVEL (10)	0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

	20.2201(b)		20.2203(a)(2)(v)		50.73(a)(2)(i)		50.73(a)(2)(viii)
	20.2203(a)(1)		20.2203(a)(3)(i)		50.73(a)(2)(ii)		50.73(a)(2)(x)
	20.2203(a)(2)(i)		20.2203(a)(3)(ii)		50.73(a)(2)(iii)		73.71
	20.2203(a)(2)(ii)		20.2203(a)(4)	X	50.73(a)(2)(iv)		OTHER
	20.2203(a)(2)(iii)		50.36(c)(1)	X	50.73(a)(2)(v)		Specify in Abstract below or in NRC Form 366A
	20.2203(a)(2)(iv)		50.36(c)(2)	X	50.73(a)(2)(vii)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Stephen R. Miller System Engineer	402-533-6882

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
	YES (If yes, complete EXPECTED SUBMISSION DATE).	X NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On October 26, 1999, with the plant operating in Mode 5 for refueling operations, procedural steps were being performed to prepare for load shedding of one of the two station 4160 V vital buses and an automatic start of its associated diesel generator (DG). As part of the setup, normal station lighting is transferred from one vital bus to the other. When the control room (CR) operator performed the step to transfer lighting, a loss of normal lighting and power to both vital buses occurred. Emergency lighting actuated and functioned as designed until normal lighting was restored. The loss of power caused a loss of shutdown cooling (SDC). The CR operators restored power to the vital buses using the DGs. SDC was lost for about 2 minutes with no temperature rise.

An extensive investigation was conducted to determine the cause of the event. The root cause is the introduction of an electrical noise spike into the 125 VDC system from the electromagnetic coupling of the 125 VDC system with the 4160 V system during operation of the lighting transfer switch due to wiring practices employed when the switch was installed. It was also determined that a recent modification had removed a significant amount of capacitance from the 125 VDC control circuit associated with a relay that initiated the event.

The lighting transfer switch has been danger tagged in the "NORMAL" position to prevent its operation until suitable corrective action can be designed to reduce the induced noise in the 125 VDC circuitry from the operation of the switch. Two filter networks have been added to the lockout relay circuit to restore the noise immunity of this circuitry.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Fort Calhoun Nuclear Station Unit Number 1	05000285	1999	-- 004 --	00	2 OF 4

TEXT *(If more space is required, use additional copies of NRC Form 366A)* (17)

BACKGROUND

The Fort Calhoun Station (FCS) has two redundant vital buses to supply the Engineered Safeguards Features (ESF). Each vital bus is connected to a diesel generator (DG) (EIIS:DG) capable of supplying all safeguards loads connected to its 4160 volt alternating current (VAC) bus (EIIS:BU) and associated 480 VAC system. Control Board (CB) 20, in the control room, is the central location for remote operation of the plant electrical system.

The off-site transmission system connects the Fort Calhoun Station (FCS) switchyard to the electrical grid for distribution of the power produced and to provide a reliable source of power to station auxiliaries. Three 345 kilovolt (kV) transmission lines connect the on-site switchyard to the 345 kVAC portion of the grid. Each of the three 345 kVAC lines connected to the FCS substation has sufficient capacity to carry all of the station output. A second high voltage (161 kV) system provides power to the station's 4160 VAC vital buses (1A3 and 1A4). Three 161 kVAC transmission lines connect the on-site 161 kVAC portion of the switchyard to the 161 kVAC grid. The 345 kVAC and 161 kVAC systems are interconnected in the station's switchyard by two 500 Mega Volt Ampere (MVA) autotransformers (EIIS:XMFR).

An automatic load transfer feature is installed on the station's 4160 VAC vital buses. This automatic transfer (referred to as fast transfer) is used to transfer the 4160 VAC buses to their alternate sources in the event of failure of the normal source. The time involved in the transfer is short enough (six to eight cycles) that there are no losses of auxiliary systems or fluid transients that could cause a plant trip. Fast transfers are possible only if the voltage-phase angle conditions are acceptable between the sources, thus preventing severe supply transients and possible motor overstress and damage. The fast transfer feature is disabled when the station is shutdown.

The station's 4160 VAC and 480 VAC vital buses supply critical station loads such as high pressure safety injection pumps (HPSI) and low pressure safety injection pumps (LPSI) (the LPSI pumps supply shutdown cooling), one of the three auxiliary feedwater pumps, both sets of pumps to the ultimate heat sink (component cooling and raw water), the station's normal lighting, and a variety of other loads.

Station lighting is supplied from the 4160 VAC station vital buses 1A3 and 1A4 through transformers T1C-3A and T1C-4A. A transfer switch, FT-T1C-3A, 4A, allows ESF testing without the loss of any station lighting and is not used during power operation of the station.

EVENT DESCRIPTION

On October 26, 1999, with the plant operating in Mode 5 for refueling operations, ESF surveillance test OP-ST-ESF-0002, "Diesel Generator No. 1 and No. 2 Auto Operation," was being performed. The purpose of this test is "To satisfy, each refueling, the requirements of Technical Specification 3.7(1)c and 3.7(1)d for testing Diesel Generator 1, DG-1 (DG-2), Auto-Start initiated by a simulated loss of 4160 Volt supply to bus 1A3 (1A4) with load shedding." This test is performed with the reactor in Mode 4 or Mode 5 (i.e., cold shutdown or refueling conditions). Procedural steps were being performed to prepare for load shedding of bus 1A3 and an automatic start of Diesel Generator No. 1. As part of the test setup, procedure OP-ST-ESF-0002 step 7.12 instructs the operator to "Supply T1C-3A and T1C-4A from Bus 1A4 per OI-EE-5."

Operating Instruction OI-EE-5, "Station Lighting Bus and Transformer Operations," Attachment 1, "Transferring Bus 1C3A to 4.16 kVAC Bus 1A4," provides instructions to accomplish the transfer operation.

When the control room operator performed the step to transfer lighting per the procedure at 0132 hours Central Standard Time (CST) on October 26, a total loss of normal station lighting and 4160 VAC bus 1A3 and 1A4 power occurred. The station emergency lighting actuated and functioned as designed until normal lighting was restored.

Loss of power to 4160 VAC buses 1A3 and 1A4 caused actuation of the undervoltage load shed features on buses 1A3 and 1A4 and the 480 VAC vital buses. This loss of power event caused a loss of shutdown cooling since shutdown cooling motive force was being supplied from pump SI-1B (EIIS:P) at the time that the event occurred. SI-1B receives power from 4160 VAC bus 1A4.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Fort Calhoun Nuclear Station Unit Number 1	05000285	1999	– 004	– 00	3 OF 4

TEXT *(If more space is required, use additional copies of NRC Form 366A)* (17)

Upon recognition that a loss of power to buses 1A3 and 1A4 had occurred, the control room operators repositioned the diesel generator control switches from the normal shutdown position of "OFF AUTO" to "AUTO." This action energized the vital buses at 0134 hours CST. Shutdown cooling was lost for about 2 minutes and was restored when the diesel generators were taken to the "AUTO" position and the vital buses re-energized. The control room operators then proceeded in an orderly restoration of power to buses 1A3 and 1A4 in accordance with Abnormal Operating Procedure AOP-32, "Loss of 4160 Volt or 480 Volt Bus Power Instructions." The shutdown cooling temperatures indicated that no temperature rise had occurred during the loss of shutdown cooling.

At 0206 hours CST an Alert was reported to the NRC Operations Center. The Alert was reported under Emergency Action Level (EAL) 4.3, but had not been declared. The conditions for the Alert were cleared within about two minutes when the station vital buses were re-energized. This event is being reported pursuant to 10 CFR 50.73(a)(2)(iv), 10 CFR 50.73(a)(2)(v)(B), and 10 CFR 50.73(a)(2)(vii)(B).

SAFETY SIGNIFICANCE

Loss of power to the 4160 VAC vital buses 1A3 and 1A4 occurred during a routine transfer of station lighting transformer T1C-3A from its normal source, bus 1A3, to its alternate source, bus 1A4. The cause of loss of power to buses 1A3 and 1A4 was spurious actuation of 161 kVAC system fast transfer lockout relay 86X/FT161 (EIIS:86) due to an electrical noise spike introduced on DC bus Number 2 from the operation of lighting transfer switch FT-T1C-3A, 4A (EIIS:JS). Relay 86X/FT161 is the relay that actuates a fast transfer of the vital buses from their 161 kVAC source to the 345 kVAC source when there is a fault on the 161 kVAC system. Relay 86X/FT161 is powered from DC bus number 2.

The plant was in refueling shutdown condition, Mode 5, with shutdown cooling in service. Both 345 kVAC and 161 kVAC sources were available (although fast transfer was not enabled with the main generator off line), and diesel generators DG-1 and DG-2 were available. The diesel generator control switches were in "OFF-AUTO" per plant procedures. The fuel for the next operating cycle (19) was in the reactor vessel. The reactor coolant system was not at a reduced inventory level when the event occurred. The reactor cavity was flooded at the time of the event. Refueling operations were not in progress at the time of the event.

Shutdown cooling was lost for approximately 2 minutes and was restored when the diesel generators were placed on their respective buses. Shutdown cooling temperature indicated zero degrees rise in the 2 minutes that shutdown cooling was lost. This event caused an unplanned loss of power to buses 1A3 and 1A4, loss of shutdown cooling, and loss of spent fuel pool cooling for approximately 2 minutes. The available inventory of the reactor coolant system and spent fuel pool was such that a two minute interruption of cooling to these systems allowed a negligible increase in system temperatures.

Both offsite power sources were available throughout the event, and the DGs were manually started and placed in service in response to bus 1A3 and 1A4 loss of power. All undervoltage load shed circuitry responded as designed for the emergency buses.

It should be noted that had this event occurred at power, the station vital buses would have automatically been powered from the 345 kVAC grid by the fast transfer circuitry. It has been concluded that this event had minimal effect on plant/public safety.

CONCLUSION

An extensive investigation was conducted to determine the cause of the event. Operation of lighting transfer switch FT-T1C-3A, 4A was observed to be coincident with the occurrence of the event, but its association with the spurious actuation of relay 86X/FT161 was not readily apparent. A review was conducted of recent modifications to the plant that had any effect on either of the two circuits involved. It was determined that modification MR-FC-98-001 (Switchyard Upgrade Project) removed the mimic bus indicating lights associated with the 161 kVAC Substation circuit breakers from the 125 VDC control circuit associated with relay 86X/FT161.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Fort Calhoun Nuclear Station Unit Number 1	05000285	1999	-- 004 --	00	4 OF 4

TEXT *(If more space is required, use additional copies of NRC Form 366A)* (17)

The effect of removing the mimic bus indicating lights from the relay 86X/FT161 circuit was that a significant amount of capacitance (estimated to be 0.2 micro-farads (μF) due to 5 pairs of cables that extended between the control room and the switchyard, approximately 1/4 mile in length) was removed from the circuit. Removing the mimic lights from the circuit essentially removed an electrical noise filter from the circuit. The circuit was subsequently more susceptible to the effects of noise-induced electrical spikes.

The root cause for this event is the introduction of an electrical noise spike to relay 86X/FT161 control circuit due to the electromagnetic coupling of the 125 VDC system with the 4160 VAC system during operation of switch FT-T1C-3A, 4A due to wiring practices employed when the switch was installed. Relay 86X/FT161 and the station lighting transfer switch were installed as modifications following the initial construction of the plant. The removal of the mimic bus indicating lights allowed the electrical noise spike created from operation of the lighting transfer switch to have more influence on the relay 86X/FT161 control circuit.

Two Contributing Causes to this event have been identified:

1. Modification MR-FC-98-001 removed the 161 kVAC mimic bus indicating lights from the control power circuit for relay 86X/FT161. The effect of this was the inadvertent removal of a capacitance filter, making the circuit more susceptible to the effects of electrical noise spikes.

2. The 125 VDC control wiring cable loom tie wrap blocks in the enclosure for switch FT-T1C-3A, 4A had lost adhesive and were no longer attached to the enclosure, allowing the cable loom to come close to the 4160 VAC cables. The effect of this is an increase in the amount of electromagnetic coupling between the 125 VDC and 4160 VAC systems within the enclosure during the operation of the transfer switch.

CORRECTIVE ACTIONS

A root cause analysis has been completed and resulting appropriate corrective actions have been developed to correct the contributing causes to this event. These additional corrective actions, while not commitments, will be implemented through the condition reporting system.

The station lighting transfer switch has been danger tagged in the "NORMAL" position which will prevent its operation until suitable corrective action can be designed to reduce the induced noise in the 125 VDC circuitry from the operation of the switch. In addition, two filter networks have been added to relay 86X/FT161 circuit to restore the noise immunity of this circuitry.

Current wiring practices employed in the FCS switchgear and cable tray systems do not typically allow the opportunity for coupling of either the 4160 VAC or 480 VAC systems with the 125 VDC or 120 VAC control and instrumentation systems. Within the switchgear, power cables are typically separated from the control cables by metallic barriers. In the cable tray systems, physical separation between power cables and instrumentation/control cables and triplexing of power cables are the methods employed to reduce potential electromagnetic interference sources. There are no other known installations in the station which have the 4160 VAC and 125 VDC systems this close to each other with no barrier between them.

SAFETY SYSTEM FUNCTIONAL FAILURE

This event resulted in a safety system functional failure in accordance with draft NEI 99-02, Rev. D, due to the loss of both vital buses and their attendant equipment.

PREVIOUS SIMILAR EVENTS

No similar previous events have been identified.